REMARKS

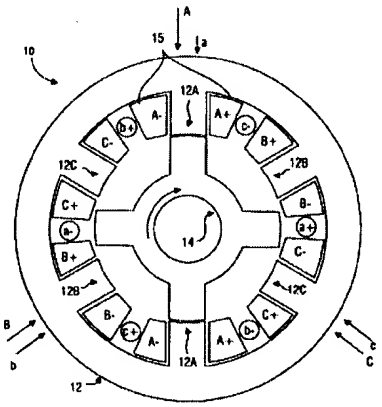
Claims 1-21 are now pending in the application. The Examiner is respectfully requested to reconsider and withdraw the rejection(s) in view of the remarks contained herein.

REJECTION UNDER 35 U.S.C. § 103

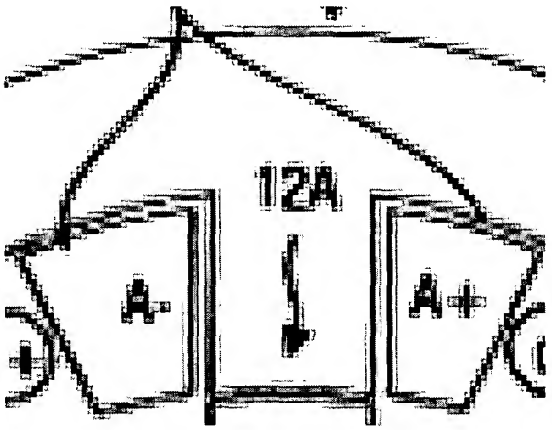
Claims 1-5, 8-13, 16-18, and 21 stand rejected under 35 U.S.C. § 103 as being anticipated by Tang (U.S. Patent No. 5,811,905) in view of Takeuchi et al. (U.S. Patent No. 5,583,387) and Oki (JP Pat. No. 411289701A). This rejection is respectfully traversed.

With respect to independent claims 1, 9, and 16, Tang does not show, teach or suggest a switched reluctance machine with a segmented stator, as admitted by the Examiner.

Tang also does not show, teach or suggest a stator having a slot fill that is greater than 65%. The Examiner now asserts that Tang inherently shows a switched reluctance motor with a slot fill above 65%. In support thereof, the Examiner solely relies upon FIG. 1 of Tang, which is set forth below:



Applicants respectfully assert that FIG. 1 does not inherently show slot fill that is greater than 65% for several reasons. The drawing is in schematic form and does not appear to show relative sizes. For example, the windings are not uniformly wound around the stator teeth. In particular, A- and A+ have different sizes and are not symmetric, which would be impossible since the same winding wire that is used to wind A+ would also form A-. An enlarged view of A+ and A- is set forth below:



At best, reliance on FIG. 1 of Tang would lead to confusion.

As best understood by Applicants, the specification of Tang is silent as to slot fill. Tang also shows large gaps (labeled a+, a-, b+, b-, c+, and c-) in FIG. 1 that do not include winding wire and would reduce the slot fill percentage. Since the stator is not segmented, Applicants presume that either needle winding or transfer winding methods would be used to wind the stator. Neither of these approaches achieve slot fills that are greater than 65%. **Applicants Specification ¶ [00015].** At best, Tang could achieve 60-65% slot fill with the transfer winding approach discussed by Applicants. **Id.**

Furthermore, Applicants are not claiming high slot fill in isolation. Applicants have claimed high slot fill in combination with a segmented stator switched reluctance machine. By allowing the stator segments to be wound before assembly (which can

only be done with segmented stators), the electrical uniformity of the inductance and resistance values of the stator poles can be improved. This, in turn, allows the sensorless approach (claimed in claims 8 and 21) to be used more successfully.

Takeuchi et al does not show, teach or suggest a switched reluctance machine. Takeuchi et al. relates to permanent magnet machines, not switched reluctance machines.

Oki does not show, teach or suggest a stator having a slot fill that is greater than 65%. Oki also does not expressly address switched reluctance machines. The Examiner incorrectly characterizes Oki by stating that "Oki teaches ... for the purpose of making a motor with superior electromagnetic performance that a reluctance motor may be made by having a segmented stator." **Office Action at p. 4.** In support of this statement, the Examiner relies upon FIG. 4 of Oki, which admittedly shows a segmented stator.

However, the text of Oki clearly states that the stator was segmented to make the assembly/manufacturing of the machine easier. Oki states:

> Accordingly, due to the fact that the stator is divided for each electrode unit, it is possible to readily carry out the coil-winding operation for each layered core, so as to enhance the efficiency of producing reluctance motors.

Oki translation at pp. 3-4. Therefore, Oki segments that stator to make manufacturing easier – not to improve the electromagnetic characteristics of the switched reluctance machine or to make the sensorless approach easier to implement. As was sent forth in the Amendment dated 2/24/03, Oki fails to increase the slot fill beyond the percentage that could be obtained using a non-segmented stator. As best understood, the only

portion of Oki that relates to improving electromagnetic performance is the removal of caulking and welding of the stator laminations.

With respect to dependent claims 8 and 21, neither Takeuchi et al. nor Oki show, teach or suggest a sensorless drive circuit that energizes the winding wire around the stator segment assemblies based on a rotational position of the rotor.

In rejecting the claims, the Examiner incorrectly relies on **In re Fine**, 5 U.S.P.Q.2d, 1596 (CAFC 1988) and **In re Jones**, 21 USPQ.2d 1941 (Fed. Cir. 1992). **Office Action at p.7.** The facts and the holdings of these cases do not support the Examiner's conclusion under §103.

In both cases, the CAFC reversed the Board and the Examiner based upon the Examiner's unsupported reliance upon the general knowledge of one skilled in the art. As was done in this case, the Examiners in both **In re Fine** and **In re Jones** combined features of two references in the same broad category of art and relied upon the general knowledge of one skilled in the art in making the combination. As was done in this case, the Examiners in **In re Fine** and **In re Jones** did not support the combinations by identifying specific teachings, suggestions or motivations found in the references.

To reach a proper conclusion under §103, the Examiner must step back in time and into the shoes of the person of ordinary skill in the art when the invention was unknown and just before it was made. **In re Fine** at 1598. In light of all of the evidence, the Examiner must determine whether the claimed invention would have been obvious at that time to that person. **Id.**

As recognized in Tang and in Applicants Background of the Invention, switched reluctance machines require rotor position information for control. There are two

approaches that are commonly used. The sensed approach uses a sensor that physically senses the rotor position. The sensed approach typically renders the switched reluctance machines too costly to compete with other types of machines. The increased cost has been a significant factor preventing the widespread use of switched reluctance machines.

To reduce costs, various sensorless approaches have been attempted. The sensorless approaches estimate rotor position from sensed machine characteristics such as back-EMF. Tang teaches that accurately estimating rotor position based on back-EMF is difficult due to the relatively low back-EMF signals.

Applicants determined that improving the electromagnetic characteristics – in other words, improving the uniformity of the inductance and resistance values of the stator poles – would also improve the performance of the sensorless approach. By segmenting the stator, the stator poles could be wound with improved precision, which improves the electrical uniformity of the stator poles, and with higher slot fill.

As will be demonstrated below, none of the references suggest a solution to the problem of implementing a switched reluctance machine using the sensorless approach. In particular, none of the references teaches the specific solution set forth in claims 1, 9 and 16. In fact, the problems that are addressed by each of the three references are mutually exclusive. Therefore, there is no teaching, suggestion or motivation in these references to support the combination of these references.

More particularly, Tang teaches a switched reluctance machine that includes a non-segmented stator with low slot fills. Since a non-segmented stator is used, needle winding or transfer winding methods must be employed, which limit the slot fill to less

than 65%. Furthermore, these methods do not have the accuracy of precision winding methods that can be used when the stator is segmented.

Tang recognizes that the increased costs of employing rotor position transducers (RPTs) makes switched reluctance machines uncompetitive with respect to open loop induction machines. **(Tang, Col. 1, lines 46-52)**. Tang also recognizes that implementing the "sensorless" rotor position approach in switched reluctance machines is difficult due to the low back-EMFs induced in the un-energized phase windings. **(Tang, Col. 1, lines 52-60)**.

Tang does not discuss either torque density or space saving as potential problems in switched reluctance machine applications. Tang also does not provide any discussion that would lead a skilled artisan to segment the stator or to seek art that includes a segmented stator. Tang also fails to identify the variable electromagnetic characteristics of conventionally-wound windings as a problem when using the sensorless approach.

To supplement the teachings of Tang, the Examiner relies upon Takeuchi et al., which teaches a permanent magnet machine with a segmented stator. **(Takeuchi et al. Col. 1, lines 14-17).** The problems that are addressed by Takeuchi et al., however, are different that those encountered by Tang. In particular, Takeuchi et al. segmented the stator of a permanent magnet machine to improve the torque density and to save space at the ends of the windings. **(Takeuchi et al. Col. 1, lines 19-24)**. The problems that are addressed by Takeuchi et al. (specifically low-back EMFs and the high cost of RPTs) do not relate to the problems encountered by Tang (torque density and saving space).

The Tang and Takeuchi et al. references do not discuss common problems that might motivate a skilled artisan to combine the references. In other words, these references are directed towards solving distinctly different, mutually-exclusive problems. Furthermore, the properties of and control approach for permanent magnet motors is significantly different than the properties of and control approach for switched reluctance machines. Based on the foregoing, there is no teaching, suggestion or motivation to combine Tang with Takeuchi et al.

The Examiner further relies upon Oki. Oki does not expressly address switched reluctance machines at all. Oki does not discuss sensorless control or problems that are associated with sensorless control. Oki is directed to the problem of poor electromagnetic performance of a reluctance machine due to the conventional caulking and welding of the stator plates. Oki states:

> Accordingly, due to the fact that the stator is divided for each electrode unit, it is possible to readily carry out the coil-winding operation for each layered core, so as to enhance the efficiency of producing reluctance motors.
>
> **[Problems to be solved by the Invention]** However, since the above-described prior art stator had electrodes formed by the layering of thin copper sheets, it was necessary to caulk and weld the tip parts of the electrodes, so that the electrodes would not become misaligned. There was thus the resulting drawback that the electromagnetic performance was affected at the caulking and welding sites, which lowered the performance of the reluctance motors.

Oki translation at pp. 3-4. Therefore, the caulking and welding was used to prevent misalignment of the layered stator plates in prior reluctance machines. Oki improved the electromagnetic performance of the electric machine by eliminating the caulking and welding.

Oki disclosed a complex winding tension technique that eliminated the caulking and welding and improved the electromagnetic efficiency of the reluctance machine. The Oki winding technique reduces the number of winding turns on the outer circumference side as compared to the inner circumference side. Clearly, the improved electromagnetic characteristics are a result of the elimination of the welding and caulking – not segmenting the stator.

According to Oki, the stator of the reluctance machine is segmented to improve manufacturing efficiency. **Id.** Oki also does not increase the slot fill above levels that can be obtained through conventional methods. In particular, the slot fill of the segmented stator in Oki is approximately 62%, which is approximately in the range of conventional transfer winding (approximately 60-65% slot fill). **Declaration of Dr. Wallace at Paragraphs 3-4, submitted with Amendment 2/24/03**. Therefore, Oki did not segment the stator to improve the torque density either.

The prior art fails to provide the requisite teaching, suggestion or motivation that is required under §103 and by the CAFC in both **In re Fine** and **In re Jones**, upon which the Examiner relies. In fact, the unsupported reliance on the general knowledge of one skilled in the art that was made by the Examiner here is exactly the type of conclusion that supported the reversal of the Board and the Examiner by the CAFC in both **In re Fine** and **In re Jones**.

In supporting the combination, the Examiner states that the references "are well in the field of electric machines." **Final Office Action** at paragraph 7. The Examiner goes on to state:

> In response to applicant's arguments that there is no suggestion to combine the references, the examiner

> recognizes that obviousness can only be established by combining and modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See In re Fine, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988) and In re Jones, 958 F.2d 347, 21 USPQ.2d 1941 (Fed. Cir. 1992). **In this case, the references deal with electric machines, especially motors and improvements of such machines.**

Final Office Action at paragraph 8 (Emphasis added). In summary, the only teaching, suggestion, or motivation that is relied upon by the Examiner is simply that the references all relate to electric machines.

The Examiner's reasoning is exactly the type of speculation that formed the basis for reversal of the Examiner and the Board in **In re Jones**:

> Conspicuously missing from this record is any evidence, other than the PTO's speculation (if it be called evidence) that one of ordinary skill in the herbicidal art would have been motivated to make the modifications of the prior art salts necessary to arrive at the claimed 2-(2 '-aminoethoxy) ethanol salt... We conclude that the PTO did not establish a prima facie case of obviousness.

In re Fine also rejected this reasoning. The prior art reference related to a similar device – namely gas chromatographs. **Id.** The prior art chromatograph detected sulfur while Applicants' chromatograph detected nitrogen. **Id.**

Both **In re Fine** and **In re Jones** reject the proposition that the teaching, suggestion or motivation required by §103 is present simply because the references all relate to the same broad category of art or that unsupported general knowledge of one skilled in the art can be relied upon. The Examiner is essentially asserting that it would be obvious for skilled artisans to try the features of one device in another similar device. The CAFC expressly rejected the "obvious to try theory" in **In r Fin** at 1598.

The sole motivation for making the proposed combination is provided by Applicants' specification, which is impermissible hindsight reconstruction. As succinctly stated by the CAFC:

> But this court has said, "To imbue one of ordinary skill in the art with knowledge of the invention in suit, when no prior art reference or references of record convey or suggest that knowledge, is to fall victim to the insidious effect of a hindsight syndrome wherein that which only the inventor taught is used against its teacher." W. L. Gore , 721 F.2d at 1553, 220 USPQ at 312-13. It is essential that "the decisionmaker forget what he or she has been taught at trial about the claimed invention and cast the mind back to the time the invention was made . . . to occupy the mind of one skilled in the art who is presented only with the references, and who is normally guided by the then-accepted wisdom in the art." Id . One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention.

In re Fine at 1600.

There are also particular advantages of Applicants' construction that are unique to switched reluctance machines. Sensorless control of brushless permanent magnet machines and induction machines currently do not operate properly if the iron core is heavily saturated with magnetic flux. **Dr. Wallace Declaration at Paragraph 5, submitted with Amendment 2/24/03.** Switched reluctance machines, on the other hand, are frequently operated with levels of magnetic flux in their iron cores that exceed the levels used in other types of electric machines. **Id. at Paragraph 6.** Sensorless control systems for switched reluctance machines do operate properly if the iron core is heavily saturated with magnetic flux. **Id.**

By segmenting the stator and increasing slot fill of the switched reluctance machine, the diameter of the winding wire can be increased using the same number of

turns. **Id. at Paragraph 7.** The increased diameter of the winding wire allows increased current to be driven through the windings, which increases torque output. **Id. at Paragraph 8.** The increased current levels also increase magnetic loading and magnetic saturation. **Id. at Paragraph 9.** Therefore, the benefits of a segmented stator in combination with a high slot fill are unique to switched reluctance machines with sensorless drive circuits (such as those claimed in dependent claims 8 and 21).

Based on the foregoing, Applicants believe that Claims 1, 9 and 16 are in condition for allowance. The remaining claims are either directly or indirectly dependent upon independent claim 1, 9 and 16 and are allowable for the same reasons.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

Dated: Aug. 19, 2003

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